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A Common Approach for the Certifying of International Space Station (ISS) Basic Hardware for Ground Safety

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INTRODUCTION

In order to support the International Space Station, as well as any future long term human missions, vast amounts of logistical-type hardware is required to be processed through the various launch sites. This category consists of such hardware as spare parts, replacement items, and upgraded hardware. The category also includes samples for experiments and consumables. One attribute that all these items have is they are generally non-hazardous, at least to ground personnel.

Even though the items are non-hazardous, launch site ground safety has a responsibility for the protection of personnel, the flight hardware, and launch site resources. In order to fulfill this responsibility, the safety organization must have knowledge of the hardware and its operations. Conversely, the hardware providers are entitled to a process that is commensurate with the hazard. Additionally, a common system should be in place that is flexible enough to account for the requirements at all launch sites, so that, the hardware provider need only complete one process for ground safety regardless of the launch site.

SPACE SHUTTLE PAYLOAD GROUND SAFETY REQUIREMENTS

The requirements for the Space Shuttle payloads are contained in Kennedy Handbook (KHB) 1700.7, "Space Shuttle Payload Ground Safety Handbook". This document lays out the design and operation requirements for ground support equipment and flight hardware operations in the ground environment. Hardware providers are required to demonstrate compliance with KHB 1700.7 prior to the start of processing at Kennedy Space Center (KSC) or areas under KSC's jurisdiction.

The process by which the hardware providers demonstrate this compliance is defined in SSP 30599, "Safety Review Process" and NSTS/ISS 13830,

"Payload Safety Review and Data Submittal Requirements". The nature of the hardware determines the applicable document. For ground processing, every effort has been made to ensure both documents describe an identical process to obtain approval. The complexity of the required data submittals expands or contracts to meet the level of hazard of the hardware. The minimum size of a ground safety data package is two pages, one of which is a Certificate of Safety Compliance.

The organization that assures payload ground safety is the Payload Ground Safety Review Panel (GSRP) located at KSC. The GSRP has the responsibility to assure that all payloads and similar items comply with the applicable safety requirements and processes.

For flight safety assurance, the responsibility is shared among the Safety Review Panel, the Payload Safety Review Panel and the Safety and Mission Assurance Review Team (SMART), each located at the Johnson Space Center. Each of these organizations has specific responsibilities for the items under their jurisdiction.

HISTORY

The process described above works very well for those missions in which the payload complement consists of uniquely identifiable payloads or hardware and for those payloads made up of multiple parts, such as a SpaceLab module, where there was a single payload organization. This process also worked well for the Shuttle-MIR missions of the 1990's.

All this changed with the advent of the International Space Station (ISS). Rather than having a single Organization responsible for the mission, each payload or piece of hardware was responsible for its own ground safety approval. Also, there was a considerable increase in the amount of Government Furnished Equipment (GFE) being flown. GFE had

not previously completed the ground safety process on it own, but was generally enveloped, due to its non-hazardous nature, by whatever it was flying with.

The situation changed in early 1999, with ISS Mission 2A.1. There were hundreds of items of GFE flown on that mission to begin the outfitting of the ISS. It became obvious the existing process would create a great burden on the hardware providers. Nor could the Ground Safety Review Panel (GSRP) depend on reading the manifest to determine the actual nature of the hardware and ask for additional data. A more efficient method needed to be developed.

THE SOLUTION

The solution was a checklist, jointly developed by the GSRP and the Safety and Mission Assurance organization at JSC, which the hardware provider could fill out and submit to the GSRP. The concept was that the checklist would act as a screen to determine the need for the development of a full ground safety data package. The largest initial hurdle to overcome was the existing inventory of some 10,000 pieces of GFE at JSC. Also, most of the hardware providers were unaware of the need for demonstrating ground safety compliance. Since most providers were going through the SMART, the SMART agreed to initially review each mission's hardware and provide a summary, using the criteria from the checklist, to the GSRP for review and approval. Eventually, the hardware providers would provide the checklist to the GSRP directly.

As the process matured, the checklist evolved. Changes primarily consisted of modifications·to the questions and the addition of an approval block, as many of the providers were requesting the return of signed copies.

The current format was most recently updated in the summer of 2005. The most significant change has been the growth of the checklist from a screening tool to a certification form. Additionally, the form was transferred from JSC to KSC and deployed as an electronic form within the NASA system. The format has been enhanced for usability. This format will be reflected in the next revision to SSP 30599. The form is available via the GSRP web site or via request to the Executive Secretary.

Applicability of the checklist has been broadened from just GFE to both GFE and Basic Hardware. Basic Hardware is defined in SSP 30599 as "Safety analysis indicates hardware and operations have a

very low hazard potential. The identified hazards and hazard causes are controlled in accordance with ISS safety requirements and utilize standard hazard controls and verification methods as defined in JSC Form 1366." Future plans are to expand the use of the form into the payload community.

CERTIFICATION FOR GROUND SAFETY REVIEW OF BASIC HARDWARE OR GOVERMENT FURNISHED EQUIPMENT

The current format is shown in Figure 1 and consists of three pages – Pages One and Two are the form and Page Three is the set of instructions.

The form consists of a series of yes/no questions to be answered by the hardware provider. In the event of a yes answer to any of the questions, room is provided on the second page for an explanation. An example would be if the hardware contained stored energy. Describing this source as a 9V battery would allow approval without the submission of a ground safety data package.

Because the GSRP does not evaluate the flight hardware design, the provider must provide the GSRP with information concerning the completion of the appropriate flight safety review process. This provides a closed loop method to ensure both safety processes are complied with.

After completing the form, the hardware provider signs the form certifying their compliance with KHB 1700.7 and submits it for approval to the GSRP. The GSRP, upon approval, signs the form and returns it to the submitter.

USE IN THE INTERNATIONAL COMMUNITY

In April 2002, the concept of using a checklist for Basic Hardware and GFE by other ISS launch sites was presented at the ISS Multi-lateral Safety and Mission Assurance Panel (MS&MAP). The acceptability of using the checklist is based on the fact that the French launch site at Khouru and the Japanese launch site at Tanegashima use KHB 1700.7 as the basis for their ground safety requirements. The only modification necessary would be the addition of unique launch site requirements. The MS&MAP endorsed the concept.

The next launch site, after KSC, to adopt the checklist for ISS hardware was Khouru, French Guyana. The European Space Agency (ESA) issued their process as ESA-ATV-PR-13830, "Automated Transfer Vehicle (ATV) Pressurised Payload/Cargo

Safety Certification Process" in July 2004. The differences between the ATV and Shuttle checklists reflect the differences between the launch sites.

Indications from the Japanese Aerospace Exploration Agency (JAXA) are they plan on pursuing a similar process for their H-II Transfer Vehicle (HTV).

SUMMARY: A COMMON APPROACH

With the establishment of long-term international human presence in space and its attendant logistical complexity, there is a need to be efficient in a systematic manner whereby the way the launch sites provide assurance regarding the safety of personnel, flight hardware, and launch site resources during ground processing. A common approach to the process of certifying basic hardware for ground safety will enable the hardware providers to take advantage of the next available ride, from any launch site, without the confusion of which process to use. The current checklists are an efficient means of providing the ground safety communities with the necessary information to complete their responsibilities while at the same time reducing the administrative costs for both the approvers and providers.

CERTIFICATION FOR GROUND SAFETY REVIEW OF BASIC HARDWARE OR GOVERNMENT FURNISHED EQUIPMENT (GFE)

1. Flight/Mission:	2. Hardware/GFE Name:	3. Part Number:	
4. Brief description of hardware/GFE (not to exceed block size):			
Ground Safety Review Questions			
A YES answer to any of the following questions may require submission of a Ground Safety Data Package. Final determination will be made by the GSRP Chairman upon review of the checklist. (Provide an explanation of a yes answer to any of the following questions in the remarks block 17 on page 2.)			Yes / No
5. For unmodified re-flight items, has the Payload/Cargo item previously been processed through the GSRP Safety office? If YES, provide date of previous GSRP approval; sign form and submit to address indicated			
6. Does the item require preflight or postflight ground processing at KSC other than installation or removal into or from the Orbiter or carrier?			
7. Does the item contain hazardous, or biological, materials?			
8. Does item require any ground support equipment (GSE), provided by the developer, to process the flight hardware at KSC?			
9. Can ground personnel be exposed to excessive temperatures (less than 0°C or greater than 45°C)?			
10. Can ground personnel be exposed to sharp edges, protrusions, or moving parts?			
11. Does the item contain ionizing or non-ionizing radiation sources?			
12. Does the item or its (GSE) contain any stored energy (i.e., mechanical, pressure, or electrical)?			
13. Can personnel come in contact with voltages in excess of 30 volts AC or 50 volts DC during nominal or unplanned maintenance?			
14. Has any Commercial Off the Shelf (COTS) GSE been modified from its original design?			
15. Does the item require fluid servicing (e.g. gas, liquid, cryogenics, and propellants) or hazardous material handling (e.g. sample preparation) at KSC?			
16. Has item completed the appropriate Flight Safety Review (e.g. PSRP, SMART) Process? If (YES): Date:_____ and indicate appropriate Flight Safety panel (PSRP, SMART, SRP).			

Figure1. Certificate of Ground Safety Review of Basic Hardware or GFE

CERTIFICATION FOR GROUND SAFETY REVIEW OF BASIC HARDWARE OR GOVERNMENT FURNISHED EQUIPMENT (GFE)

17. Remarks:

The Hardware/GFE provider hereby certifies that the hardware/GFE complies with all applicable requirements of KHB 1700.7.

18. Name (print):	19. Signature:	20. Date :
21. Phone Number:	22. Fax Number:	23. Electronic Mail Address:

Send to:

NASA/SA-C3
Executive Secretary, GSRP
Kennedy Space Center, FL 32899

GSRP Chairman:

24. Name:	25. Signature	26. Date:

Instructions

Block 1. State the Flight STS number and ISS mission for the assigned item. (If applicable)
Block 2. State the item name of the cargo/payload item. Use the same name for the item as what was manifested.
Block 3. State the part number for the item. Use the same part number for the item as what was manifested.
Block 4. State a description of the item, describe size, shape weight, characteristics of the items.

Ground Safety Certification Questions

A yes answer to any of the following questions may require submission of a Ground Safety Data Package. Final determination will be made by the GSRP chairman upon review of the checklist.

Blocks 5 – 15, answer the questions in the appropriate blocks with a yes or no. Block 6 explain any processing activities preflight and post flight that are required other than ship and shoot and/or land and ship. A yes answer requires a description in the remarks block 17 for each question with a yes answer as to what the hazards are and how they are controlled.

Block 16. State the appropriate Flight Safety review (i.e. PSRP, SRP or SMART) date that it was approved for use on the manifest.

Blocks 18 – 23 are filled in by the payload organization item provider that is certifying that the item complies with all the requirements of KHB 1700.7.

Send completed form to the address shown on page 2.

Figure1. Certificate of Ground Safety Review of Basic Hardware or GFE
Continued

A Common Approach for the Certifying of

ISS Basic Hardware for Ground Safety

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Introduction

- Logistics support to long term human presence in space

- Most items are non-hazardous

- Launch site ground safety responsibilities
  - Protect personnel and hardware
  - Need to know and understand all items

- Process should be commensurate with hazard

- A common approach is needed for all launch sites

Space Shuttle Payload & ISS Ground Safety Requirements

- Ground safety requirements in KHB 1700.7, "Space Shuttle Payload Ground Safety Handbook"
  - Design and operations requirements for Ground Support Equipment
  - Requirements for flight hardware in the ground environment
- Demonstration of compliance required prior to the start of ground operations

Space Shuttle Payload & ISS Ground Safety Requirements (cont.)

- Ground Safety Process found in SSP 3599, "Safety Review Process" and NSTS/ISS 13830, "Payload Safety Review and Data Submittal Requirements"
  - Identical ground processes
  - Complexity of data submittal expands or contracts with level of hazard
  - Minimum data package size
- The Ground Safety Review Panel (GSRP) assures compliance

History

- Until the start of the International Space Station (ISS), payloads uniquely identifiable
- Multiple piece payloads (SPACELAB) integrated for safety review purposes
- Under ISS, almost every piece an individual "payload"
- Increase in Government Furnished Equipment (GFE) and other such items
- ISS 2A.1 – Watershed event

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The Solution

- Ground Safety Checklist
  - A screening tool
  - 10,000 existing pieces of GFE
  - Assistance given by the Johnson Space Center Safety and Mission Assurance Review Team
- Evolution of the Checklist
  - Modification of questions
  - Certification and approval blocks
- Expansion of applicability
  - From just GFE to all Basic Hardware
  - Expansion into payload community

Checklist Form

- Latest version
  - Summer 2005
  - Yes/No answers – screening function
  - Flight approval process
  - Certification
- The form is available via the web or via request to the GSRP Executive Secretary

International Use

- Multilateral Safety and Mission Assurance Panel (MSMAP)
  - Common basis of ground safety requirements
    - CNES at Khuoru, French Guyana
    - JAXA at Tanegashima, Japan.
  - Concept approved – April 2002
- Adopted and adapted by the ESA and CNES for the Automated Transfer Vehicle (ATV) in ESA-ATV-PR-13830, "Automated Transfer Vehicle Pressurised Payload/Cargo Safety Certification Process."
- JAXA and the H-II Transfer Vehicle (HTV)

A Common Approach

- Long-term human space presence requires large amounts of logistics

- Assurance of the safety of ground personnel, ground equipment and flight hardware

- A common approach across the launch sites will assist in keeping the logistics moving

- The ground safety checklist is offered as the basis for that common approach